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ABSTRACT

Kindergarten children were exposed to a behavior modification training activity involving perceptual scanning, which was designed to increase the field-independent mode of perception. The training was evaluated, based upon a group of 18 experimental subjects and a control group of 17 children. Subjects in the training group were individually trained in eight sessions with continuous and delayed reinforcement. All subjects were tested on the Preschool Embedded Figures Test and Children's Embedded Figures Test, and pre- and post-tested on the Muller-Lyer and Poggendorff Illusions to determine changes in level of field dependence-independence. Results indicated that field-dependent children tended to improve more than field-independent children on the Children's Embedded Figures Test and the Poggendorff Illusion. Training improved all children's performance on the Muller-Lyer Illusion. (Author/GDC)

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Visual-Perceptual Training of Field-Dependent and Field-Independent 5-Year-Olds: An Increase in Analytic Visual Ability

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Abstract

The present study evaluated the effectiveness of behavior modification training in perceptual scanning activity aimed at increasing a field-independent mode of perception in kindergarten children. There were 18 children in the Training group, 17 in the Control. They were individually trained in 8 sessions with continuous and delayed reinforcement. All subjects were tested on the Preschool Embedded Figures test (PEFT) and Children's Embedded Figures test (CEFT), and pre-and-post tested on the Muller-Lyer and Pogendorff Illusions to determine change in level of field-dependence-independence (FDI). Results indicated that FD children tended to improve more than FI children on the CEFT and the Pogendorff Illusion. Training improved all children's performance on the Muller-Lyer Illusion.

Visual-Perceptual training of Field-Dependent and Field-Independent 5-Year-Olds: An Increase in Analytic Visual Ability

The purpose of this study was to determine whether perceptual training could facilitate the development of field-independent abilities or analytic attitude in young children. Organized visual activity involving ability to search effectively for hidden or embedded aspects of tests of field-dependence-independence (FDI) has been shown to be positively related to field-independence (Britain, 1958, Conklin, Muir and Boersma, 1968). Such behavior probably reflects the ability to control and direct attention characteristic of field-independent (FI) individuals (Witkin, Dyk, Faterson, Goodenough and Karp, 1962). The standard tests of FDI require the individual to visually separate a relevant item from a highly organized field, dominated by an embedding context. Non-salient aspects of the field which are incorporate within the whole structure, must be disembedded and identified. Examples of this type of perceptual task are the Preschool Embedded Figures Test (PEFT) (Coates, 1972), the Children's Embedded Figures Test (CEFT) (Witkin, Oltman, Raskin, and Karp, 1971), and the Embedded Figures Test (EFT) designed for adults (Witkin, et al., 1962).

In preliminary studies of FDI, Witkin (1950) did not indicate that field-dependent (FD) and field-independent (FI) individuals differ in their perceptual search strategies; he did describe different

approaches to solution of the EFT noting that many FD individuals had to trace lines with their finger or pencil as an aid in searching for the simple figures. In response to Witkin (1950), Conklin, Muir and Boersma (1968) argued that tracing movements corresponded to eye movements and that those with active eye tracing movements should be able to solve analytic visual tasks faster. They found that FI individuals tried to impose structure on ambiguous configurations by using longer and more random (not fixated on salient aspects) eye movements than did FD individuals. Others have reported evidence of a relationship between field-independence and extensive scanning activity. Boersma, Muir, Wilton, and Barham (1969ab) found that FI individuals tended initially to spend less time examining specific letters of anagrams than FD, but they made more eye movement shifts during solution. Britain (1969) found that FI individuals intensified their scanning patterns while solving EFT items under stressful conditions. In contrast, scanning patterns of FD individuals tended to become rigid or chaotic under stress. Britain (1969) argued that FD individuals showed less organization in their eye movements than did FI by evidencing more erratic movements, longer fixations, and more blinking behavior under stress than under neutral conditions.

Related research, excluding the FDI factor, indicated that active perceptual scanning leads to successful solution on a variety of visual tasks such as revolving pointer detection (Mackworth, Kaplan and Metlay, 1964), image detection (Luborsky, Blinder and Mackworth, 1964) anagrams

(Kaplan and Schoenfeld, 1966), conservation tasks (O'Bryan and Boersma, 1971; Boersma and Wilton, in press), memory-sequencing (Britain and Wolff, 1979). Although there is some controversy (Burdick, 1965; Barrett, Cabe and Thornton, 1968) concerning the notion that FI and FD individuals differ with respect to visual, scanning activity, the majority of research indicates that FI individuals are more perceptually active than are FD, and they are more visually analytical and successful in overcoming visually embedding contexts.

Given that field-independence and extensive organized scanning are related to each other and to successful performance on a variety of visual tasks, it would be worthwhile to attempt to foster active visual scanning in children when they are beginning to consolidate perceptual strategies. Vurpillot (1968) indicates that such scanning does not appear to become organized until the beginning of the concrete operational stage of development, at about 6 or 7 years of age. There has been little evidence that FD or FI children can be trained to modify perceptual scanning behavior. There have been a few attempts to train individuals on specific tasks related to either scanning or FDI (McAllister, 1970; Slator, 1971). Zangwill and Blakemore (1972) and Elkind and Deblinger (1969) argued that visual activities such as reading could be improved with simple perceptual training. The latter demonstrated that children trained with nonverbal perceptual exercises improved more on word recognition than peers trained

with a more typical verbal school program.

Several studies have demonstrated that specific perceptual training can facilitate the development of reflective behavior in impulsive children. Zelniker, Jeffrey, and Ault (1972) found differences in the search strategies of impulsive and reflective third graders on Kagan's Matching Familiar Figures Test (MFF). Not only did the impulsive children show more fixations and less scanning in pre-training tests than had reflective children, but also training appeared to have improved the impulsive children's scanning strategies. Others (Hemry, 1973; Siegal and Cara, 1971; and Egeland, 1974) found differential effects of reinforcement strategies on impulsive and reflecting children, all concluding that perceptual behavior was modifiable. Egeland (1974) discovered that the effect of training in visual search strategies lasted for at least two months for impulsive children.

Somewhat related to the demonstrable training of reflectivity and perceptual scanning are studies which have attempted to accelerate conservation behavior by increasing decentration activities. Decentrations have been characterized (Piaget, 1950) as percentual shifts from one point of focus, or centration, to another. O'Bryan and Boersma (1971) argued that the training of decentering eye movement patterns would accelerate cognitive development. Boersma and Wilton (in press) did find more active eye movements in trained non-conservers. It is not surprising that FI children have been found to conserve sooner than FD children (Fleck, 1972).

Although much of the above research is peripherally relevant, it was pertinent and supported the argument that style and amount of eye movement activity is of extreme significance. High levels of eye movement activity and organized scanning are related to superior performance on a variety of tasks and to analytic field-independent functioning. Diverse evidence indicated that perceptual activity is modifiable through visual training and that performance on analytic-visual tasks can be improved. The purpose of this study was to demonstrate that perceptual training, easily accomplished in a classroom situation, could enhance the performance of FD children on tests of analytic function. Training specific to analysis of complex visual configurations and to organized scanning should facilitate performance on tests of FDI. It was hypothesized that such training would result in more field-independent performance in young children who have not yet reached the stage when eye movements are organized into efficient search strategies (Vurpillot, 1968; Elkind and Flavell, 1969). Training was expected to improve analytic functioning more for FD than for FI children; the latter should be performing at optimal levels prior to training.

Method

Subjects Subjects were boys and girls from the kindergarten class of a rural school in New York. These children were all white and predominantly from a lower-middle-class background. There were 11 boys

and 7 girls in the Training group and 10 boys and 7 girls in the Control group. The age range of the children in the Training group was 5.3 to 6.8 years with a mean of 5.9 years. The age range of the Control children was 5.3 to 6.4 years with a mean of 5.4 years. All of the children possessed normal vision and hearing.

The experimental space measured 10' x 7'. Two sides were blank walls, one side was a door with a window, and the other side was a portable blackboard measuring 6' x 4'. Included within the space were 2 chairs and a small table.

Apparatus The Preschool Embedded Figures Test (PEFT) (Coates, 1972), the Children's Embedded Figures Test (CEFT) (Witkin, Oltman, Raskin, and Karp, 1971), the Pogendörff Illusion (PI) (Eccles and Britain, 1969) and the Müller-Lyer Illusion (M-L) (Lafayette Instrument Co.) were used to measure the level of FDI.

Procedure

The children were pretested on the PEFT, the PI and the M-L. They were then divided into Control and Trained groups based on sex and PEFT scores. The M-L was used as a comparison for the PI which has been related to FDI (Eccles and Britain, 1969). The trained group had 6 male and 3 female FD children, 5 male and 4 female FI children. The Control group had 5 male and 3 female FD, 5 male and 4 female FI children.

The Trained group were subjected individually to eight 15-minute individual visual-scanning training sessions every other school day over

a three week period. Each training session was progressively more complex in visual procedures. Successive approximations to the demands of the experimenter on the visual tasks were rewarded by sugared cereal and a pleasant bell sound made by the experimenter who used a funny hand puppet to give reinforcements to each subject and to strike the bell. The brief visual training tasks were presented as games about looking and paying attention. They were designed to be visually interesting and to foster active and organized visual scanning. Each session involved a visual maze, a line-length discrimination task, a simple embedded figures item, line following games, and hand movement matching tasks. Each task facilitated attention and eye following movements. The experimenter increased her demands on each day. In sessions 1 through 4, immediate reinforcement was given. In 5 through 8, reinforcements were delayed until the end of each session except that verbal knowledge of results were continually given. The training procedures were designed to be rather general and easy for teachers to incorporate into their own programs without intensive training or expensive equipment.

Following training all the children were post-tested on the CEFT, the PI, and the M-L.

Results

Of the two illusions, only the Pogendorff showed expected training effects. Small numbers of subjects prevented the results from

reaching significance for the Muller-Lyer Illusion, all children improved significantly from the pre- to the post-test. In the pre-test, all subjects appeared to greatly overcompensate for the illusion; in the post-test, all subjects, trained and control, regressed to a more typical error score. In the Pogeendorff, on the other hand, there were clear effects of training. All trained children showed a significant decrease in error following training, whereas controls showed no change. There was no difference in change between FI and FD children, an unexpected result considering the findings of Eccles and Britain (1969).

Comparison of differences in errors in inches made on the Pre- and Post-tests of the Muller-Lyer Illusion was analyzed by a 3-factor mixed design analysis of variance. It revealed a significant main effect between Training and Control ($F(1,32) = 19.60$, $p = < .001$). The subjects in the Training group had an average error of 0.1 inches and the Control group, 1.6 inches. However, the main effect between Pre-test and Post-test errors in inches indicated significance, $F(1,32) = 192.66$, $p = < .001$. Subjects on the Pre-test made an average error of -2.9 inches and on the Post-test made an average error of 4.7 inches. FDI did not have any effect on M-L performance. No other interactions were significant.

A similar analysis of variance for the PI revealed that the 3 main effects for FDI, Pre-post, Trained-Control were not significant. The interaction between Training and FDI only approached significance,

$F(1,32) = 2.39$, $p = < .2$. FDs in the Training group made an average error of 1.2 inches; FIs, 1.4 inches. FDs in the Control group made an average error of 1.7 inches; FIs, 1.4 inches. The interaction between Pre- and Post-tests and Training also approached significance, $F(1,32) = 2.44$, $p = < .2$. Subjects in the Training group made an average error of 1.5 inches on the Pre-test; 1.2 inches on the Post-test. Subjects in the Control group made an average error of 1.5 inches on the Pre-test; 1.5 inches on the Post-test. The interaction between Pre- and Post-tests and FDI, and the interaction between Pre- and Post-tests, Training, and FDI were not significant.

Comparison of differences in number of PEFT and CEFT items solved indicated a nonsignificant main effect between the Training and Control groups. There was a significant main effect between FD and FI, $F(1,32) = 84.06$, $p = < .001$. FDs solved an average of 10.6 items; FIs, 17.1 items. The interaction between Training and FDI only approached significance, $F(1,32) = 4.08$, $p = < .10$. FDs in the Training groups solved an average of 11.8 items; FIs, 16.7 items. FDs in the Control group solved an average of 9.5 items; FIs, 17.6 items. Hence, FDs in the Training group solved an average of 2.3 more items than FDs in the Control group, whereas FIs in Training group solved an average of .9 items less than FIs in the Control group.

The main effect between PEFT and CEFT was significant, $F(1,32) = 17.12$, $p = < .001$. On the PEFT, an average of 15.1 items were solved; CEFT, 12.4 items. The interaction between PEFT-CEFT and FDI was sig-

nificant, $F(1,32) = 5.54$, $p = < .05$. FDs solved an average of 11.2 PEFT items, FIs, 19.6 items. FDs solved an average of 10.0 CEFT items; FIs, 14.7 items. No other interactions were significant.

Discussion

These data appear to indicate that training had no significant effect on overall CEFT performance. However, FI children performed significantly better on both the PEFT and CEFT. Trained FD children tended to perform better than Control FDs, but Trained FI children tended to perform slightly worse than Control FI. Hence, as expected, training, to some degree, appeared to facilitate FD children more than FI.

The mean average score for the PEFT was significantly higher than that of the CEFT. However, this result is misleading in that the PEFT was designed for 3-5 year-olds and the CEFT, designed for 5-12 year-olds, is more difficult. The two tests were used because at the time of pre-testing it was determined that the CEFT was too difficult for the 4-5 year olds. Therefore all subjects were pre-tested on the PEFT 3 months prior to training. Although in terms of number of items solved, all subjects on the average solved more PEFT items than CEFT items, the greater difficulty of the CEFT indicated that there was a general improvement from PEFT to CEFT performance. The mean score on the PEFT was slightly lower than the 15.5 norm for 5 year old children on the PEFT (Coates, 1972). Conversely, the mean score on the CEFT

was higher than the 7.1 norm for 5-6 year old children on the CEFT (Witkin, et al., 1971). On the pre-test, all FI children scored above the PEFT norms (Coates, 1972) while FD scored below the norms. On the post-test, control FD children scored about at the CEFT norms (Witkin, et al., 1971) while trained FD children solved an average of 5 more CEFT items than did the normative sample, a significant difference. Both control and trained FI children solved about 8 more CEFT items than did the normative sample. Trained FD children tended to improve more than did Trained FI. In other words, FDs tended to improve with training in perceptual scanning activity whereas FIs were consistently high performers despite intervention of training. These data will be reanalyzed by converting PEFT and CEFT scores to standard scores.

In contrast to PEFT-CEFT performance, Training had a significant effect on overall Muller-Lyer Illusion performance. However, there was no significant difference between FD and FI performance.

Overall performance on the Pogendorff Illusion was similar to performance on the PEFT-CEFT in that Training did not appear to have a significant effect. However, the data indicate that Trained subjects tended to perform better on the Pogendorff Illusion than Control subjects. Pogendorff performance was also similar to Muller-Lyer Illusion performance in that FD and FI children did not differ significantly in performance. However, the interaction between Training and FDI approached significance. Trained FD children tended to have a lower average error score than Control FDs, but Trained FI children did not

differ from the Control FI. Training appeared to have some positive effect on FD children and none on FIs. This tendency was similar to that found between FD and FI performance on the PEFT-CEFT.

One factor may have affected performance on the CEFT and the Post-tests of the Muller-Lyer and Pogendorff Illusions. Since Trained subjects were accustomed to receiving reinforcement, their level of performance might have been lowered on the Post-test because of the sudden change in motivational conditions. Several trained children expressed their disappointment in not receiving reinforcement during the Post-tests.

The purpose of the present study was to determine the effectiveness of behavior modification training in perceptual scanning activity to increase the analytic ability of FD and FI kindergarten children. The results indicated that training appeared to have no effect on FI children while facilitating FD performance on the test of FDI. Perhaps FI children tend to develop efficient scanning strategies early and perform at optimal capacity. Further, they may not be as susceptible to training as are FD children. If we accept the characterization of FD children as more susceptible to external reinforcement, more conforming and more dependent on adult attention and social approval than FI children (Witkin, et al., 1962) then the following might be concluded: The training sessions provided not only perceptual training, but also close rewarding contact with a nurturant adult. She rewarded perceptual activity with attention as well as candy. The reported dif-

ference in need for social approval between FI and FD individuals might help to explain the effects which this training had on FD children. Perhaps it is possible to facilitate the development of analytic strategies in children prior to the consolidation of scanning strategies (Vurpillot, 1968) despite their tendency to show a diffuse or FD style of attending. Although these strategies may be specific to the areas trained, such training procedures may be useful in schooling.

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